FUNCTIONAL OUTCOME

IN PATIENTS WITH ANKYLOSING SPONDYLITIS

FOLLOWING HIP ARTHROPLASTY

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A dissertation submitted to the Tamil Nadu Dr. M.G.R. Medical University in partial fulfillment of the requirement for the award of M.S. Branch II (Orthopaedic Surgery) degree March 2008-2010

CERTIFICATE

This is to certify that this dissertation titled "FUNCTIONAL OUTCOME IN PATIENTS WITH ANKYLOSING SPONDYLITIS FOLLOWING HIP ARTHROPLASTY" is a bonafide work done by Dr. PRABHU JOSEPH L, in the Department of Orthopaedic Surgery, Christian Medical College and Hospital, Vellore in partial fulfillment of the rules and regulations of the Tamil Nadu Dr. M.G.R. Medical University for the award of M.S. Degree (Branch-II) Orthopaedic Surgery under the supervision and guidance of Prof. SAMUEL CHITTARANJAN during the period of his post-graduate study from March 2008 to February 2010.

This consolidated report presented herein is based on bonafide cases, studied by the candidate himself.

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INDEX

AIMS AND OBJECTIVES

The aims and objectives of the study are:

- To retrospectively analyze patients with ankylosing spondylitis who underwent hip arthroplasty in our department between January 2005 and June 2009.
- To analyze the functional outcome in these patients after surgery
- To analyze the improvement in the range of motion of the hip and the improvement in pain post operatively.
- To compare results between patients who underwent cemented, uncemented and articular surface replacement.
- To compare results between patients undergoing bilateral hip surgery in one stage and in two stages.
- To radiographically analyze presence of heterotopic ossification post operatively.

LIST OF ABBREVIATIONS

AS	Ankylosing spondylitis
THA	Total hip arthroplasty
HLA	Human leukocyte antigen
TNF	Tumor necrosis factor
MRI	Magnetic resonance imaging
NSAID	Non steroidal anti-inflammatory drug
DMARDs	Disease modifying anti rheumatic drugs
HO	Heterotopic ossification
ASR	Articular surface replacement
CRP	C Reactive protein
ESR	Erythrocyte sedimentation rate
MTX	Methotrexate
US	United States

INTRODUCTION

Ankylosing spondylitis (AS), also known as Von Becheterew`s disease or Marie – Strumpell disease, is a chronic systemic rheumatic disorder of indeterminate etiology.

It affects about 1% of the population. The age group in which AS is common is between 15 and 25 years. It is rare after 45 years and about 15% to 45 % of patients show disease onset before 16 years of age[1]. The younger the age of onset of the disease the more severe the disease is likely to be and there is a higher probability of the patient undergoing a total hip arthroplasty (THA)[2]. The average age of onset of AS is lower in developing nations.

There is a higher male to female ratio of about 2:1 to 3:1[3]. Even though the etiology is unknown there is an autosomal inheritance factor with a 70% penetrance in males and a 10% penetrance in females. This makes the relatives of an affected person 20-30 times more likely to develop AS compared to the general population[4]. There is a strong genetic trait such as a strong association with HLA-B27.

It is the prototype and the most common disorder of a group of diseases called the spondyloarthropathies. The spondyloarthropathies also include reactive arthritis, psoriatic spondyloarthritis, spondyloarthritis of inflammatory bowel disease, and undifferentiated spondyloarthritis[5].

Patients with AS may also present with peripheral arthritis, enthesitis, and acute anterior uveitis[6]. AS may be as common as rheumatoid arthritis but unlike rheumatoid arthritis, AS typically starts during the late teens and early twenties[7].

An early diagnosis is important in AS as it is associated with considerable disability, reduced quality of life, and high costs in terms of direct medical expenses and indirect costs due to lost of wages and productivity.

It has been shown that symptoms precede radiographic changes by many years further delaying the diagnostic process[8,9]. A recent review of available evidence suggests that AS has to be diagnosed early and is possible prior to the appearance of radiological changes. With the use of MRI, confirmation of sacroiliitis is made much earlier to the appearance of sacroiliitis in plain radiography[10].

It is now clear that inflammation in AS is strongly dependent upon tumour necrosis factor-α (TNF-α). Dense mononuclear infiltrates containing T cells and macrophages, secreting TNF-α, have been observed in joints of patients with AS. Additionally, trials of TNF-α inhibitors in AS have yielded impressive results supporting the pathogenic role of TNF-α in AS[11].

Clinical features: The onset of the disease is usually insidious with the onset of chronic low back ache associated with stiffness that is worse late at night and in

the morning hours or after a long duration of rest. The stiffness is alleviated with physical activity. The pain is usually a dull aching pain that cannot be well localized and is present in the gluteal area initially on one side and which later progresses to both sides. The pain then progresses on to the lumbar spine. Authors define chronic inflammatory back pain as having at least four of the following features:

- Back pain starting insidiously before the age of 45 years, of at least 3 months duration.
- Worsening with inactivity.
- Improves with activity.
- Associated with spinal morning stiffness[12].

The disease onset may be preceded by the onset of persistent or recurrent bouts of enthesitis and or lower limb oligoarthritis which may occur as long back as 5 years.

The main sites of involvement in the skeleton are in the axial skeleton (sacroiliac joints, hip joints, and shoulder joints) and there is occasional involvement of the peripheral joints[13]. Involvement of the costovertebral joints can cause severe chest pain and discomfort which worsens on coughing. The stiffness progresses to develop into fibrous and later bony ankylosis of the joints. Spinal fusion progresses to gradual development of a thoracic kyphosis[14].

Limb joint involvement is most common in the hip and shoulders and less often in the knee joints or the temporomandibular joints.

There is involvement of the sites of bony insertion of tendons which is known as enthesitis and predominantly occurs at sites where maximal stress occurs.

Extraskeletal involvement in AS affects the eyes, the gastrointestinal tract, the heart, aorta and the lungs[15]. Ocular involvement can present as acute uveitis in 20-40% of patients. Uveitis is more common in HLA B27 positive patients and can result in visual impairment[16].

Bowel involvement can present as asymptomatic mucosal inflammatory lesion in about 26-69% of patients with AS. Of these patients 6% will develop inflammatory bowel disease[2].

Aortic insufficiency and cardiac conduction disturbances or heart blocks are other uncommon extraskeletal features of AS. Aortitis of the aortic root leads to fibrosis. Some patients develop aortic insufficiency after aortic root dilation and may become haemodynamically unstable. Varying degrees of heart block are seen when there is inflammatory involvement of the atrioventricular conducting system[17].

1-2% of patients present with slowly progressing bilateral apical pulmonary fibrobullous or cavitatory disease[18]. Patients with AS are more predisposed to developing coronary artery disease due to the systemic inflammation[19].

Clinical signs: The patient on examination usually has tenderness of the sacroiliac joint on palpation or on stressing it. Stress tests include FABERE test (flexion, abduction, external rotation and extension), Patrick`s tests or Gaenslen`s maneuvers. Lateral pelvic compression or anteroposterior pelvic compression tests also reveal stress tenderness.

Mild to moderate limitation of chest expansion can be an early physical finding in patients with AS, and severe limitation is typically a late physical finding. Degree of chest expansion has limited sensitivity for diagnosis. Schober`s test and lateral flexion measures of spinal mobility may be better clinical indicators of AS[20].There is a gradual flattening of the anterior chest wall, shoulders become stooped, the abdomen becomes protuberant, and breathing becomes increasingly diaphragmatic. Involvement of the cervical spine gradually results in progressive limitation of the ability to turn or fully extend or laterally bend the neck leading to an increase in the occiput-to-wall or tragus-to-wall distances.

Spinal deformities take almost 10 years to evolve and do so in varying rates and patterns. Patients with AS can have a rigid osteoporotic spine that is prone to fracture after relatively minor trauma. Spinal osteoporosis is caused in part by the ankylosis and lack of mobility, but can also occur due to proinflammatory cytokines. There is a prevalence of about 19-62% of osteoporosis in terms of

low bone mineral density[21]. There is an increased risk of vertebral fractures in patients with AS and the relative risk is about 7.6%[22]. The prevalence of clinical vertebral fractures is about 10-17%[23]. Wedging fractures of the spine produce a progressive kyphosis. The prevalence of major neurodeficits following fractures of the spine is between 29 to 91%[24].

Transverse displaced fractures of the neck are associated with significant morbidity and mortality and can result in paraplegia or quadriplegia. Aseptic spondylodiscitis is more common in patients with cervical spine disease and occurs mostly in the midthoracic spine. It is usually asymptomatic, and can occur with minimal or no trauma. Due to chronic adhesive arachnoiditis, cauda equina syndrome can occur, though it is a rare and late complication[25]. There have been reports of spontaneous atlanto axial subluxation[26].

Diagnosis: There is an average delay in diagnosis of 3 to 11 years from onset of the disease, the delay being more in women, children, adolescents and HLA B27 negative patients[27]. The longer the delay in diagnosis, the worse the functional outcome. This is more so in juvenile – onset AS. There have not been any validated criteria for diagnosis of AS. Various criteria have been framed.

1) Rome criteria (1961) were the first to be developed[28].
2) New York criteria (1966) was developed which was more specific and sensitive.
3) The Modified New York criteria (1984) was developed which incorporated the inflammatory back pain concept[29].

The Rome criteria formulated in 1961 is still in use by clinician's:

Clinical criteria

1) Low back pain and stiffness for > 3 months which is not relieved by rest.
2) Pain and stiffness in the thoracic region.
3) Limited motion in the lumbar spine.
4) Limited chest expansion.
5) History or evidence of iritis or its sequelae.

Radiography

1) Look for evidence of sacroiliitis.
2) Exclude bilateral osteoarthritis.

Ankylosing spondylitis is said to be present if:

1) Bilateral sacroiliitis is present, AND one or more clinical criteria are present.
2) Four or more clinical criteria are present.

- The presence of bilateral sacroiliitis is considered the most important criterion for the diagnosis of ankylosing spondylitis.

The Modified New York is currently the most commonly use diagnostic criteria used in AS.

Clinical criteria

1. Low back pain and stiffness for >3 months that improves with exercise but not with rest.
2. Limitation of lumbar spine mobility in both the sagittal and frontal planes
3. Limitation in chest expansion as compared with normal range for age and sex

Radiological criteria

1. Unilateral sacroiliitis of grade 3-4* OR
2. Bilateral sacroiliitis of grade 2

Grading

1. Definite AS if the radiological criterion is associated with at least 1 clinical criterion
2. Probable AS if :
    a. 3 clinical criteria are present OR
    b. The radiological criterion is present without any signs or symptons satisfying the clinical criteria.

Table 1: *Grading of sacroiliitis[30]:

GRADE	LEVEL	DESCRIPTION
0	**Normal**	**Clear margins, uniform width, and no juxta-articular sclerosis.**
1	**Suspicious**	**Suspicious but not definite abnormality.**
2	**Minimal sacroiliitis**	**Evidence of some sclerosis and minimal erosions but no marked joint space narrowing.**
3	**Moderate sacroiliitis**	**Definite sclerosis on both sides of the joint, erosions, and widening of the interosseous space.**
4	**Ankylosis**	**Complete joint obliteration with or without residual sclerosis.**

Imaging: Radiologic evidence of sacroiliitis is the traditional hallmark in diagnosing AS. An anteroposterior radiograph of the pelvis in most patients is adequate[31]. However, in some patients where there is a high suspicion of AS when presenting early but where the sacroiliac joints are normal or shows only equivocal changes, a computerized tomography scan or MRI can be helpful.

Early changes seen on conventional radiography include squaring of the vertebral bodies and formation of syndesmophytes. Spondylodiscitis, ligamentous ossification, and involvement of the facet joints can also be present. Spinal osteoporosis is frequently seen in patients with AS, especially in patients with long term severe disease. The risk of vertebral compression fractures and pseudoarthrosis is increased in patients with spinal osteoporosis[7]. MRI is an excellent tool to demonstrate sacroiliitis, enthesitis and bony erosions. STIR technique can show ample evidence of inflammation and bone marrow edema, indicating active ongoing inflammation[32,33]. MRI also can detect disease-related changes in the dura mater, soft tissues, and spinal ligaments, as well as inflammatory changes caused by enthesitis, fractures, or pseudoarthrosis. MRI techniques to identify sacroiliitis are preferable in women of child-bearing age, in children and adolescents.

Dual energy x-ray absorptiometry (DEXA) is useful as a screening tool for osteoporosis in patients with AS, but the presence of hip arthroplasty or extensive ligamentous ossification (bamboo spine) can influence the results. Enthesitis may be detected radiographically, but not in the early stages. Ultrasound can also detect early inflammatory changes even before they appear on conventional radiographs[34].

Laboratory investigations: Ankylosing spondylitis has no specific laboratory markers that aid diagnosis. Acute phase reactants such as elevated C reactive protein (CRP) and erythrocyte sedimentation rate (ESR) are often used as part of the laboratory investigations of inflammatory rheumatic diseases. Elevated ESR and CRP are more commonly found in AS patients with peripheral arthritis than in those with only axial disease[35]. Other acute phase responses include elevated ferritin, mild thrombocytosis, and low albumin[6]. Positive rheumatoid factor and antinuclear antibody tests are not specific, nor are synovial fluid analysis and synovial biopsy .Testing for stool occult blood may be of value for inflammatory bowel disease. HLA-B27 testing should not be done routinely as AS and other spondyloarthropathies can occur in the absence of HLA-B27. HLA-B27 is present in healthy people (about 6% to 10% in Europe and slightly higher in Scandinavian countries, range 10% to16%) [36] . There is a risk of 20% in development of any type of spondyloarthropathy among HLA-B27-positive individuals with a first-degree relative with HLA B27- positive AS[37].

Treatment: To date treatment options in AS have been restricted to patient education, physical therapy, and non steroidal anti-inflammatory drugs (NSAID) being the mainstay of effective therapy.

The discovery of tumor necrosis factor-α (TNF-α) antagonists was a breakthrough in the treatment of AS. However despite these treatment options, treatment of AS has been suboptimal. Treatment involves both pharmacologic and non pharmacological means. Physical therapy involves exercises and encouragement of appropriate posture. Exercise/physical therapy programs have been shown to improve measures of pain, spinal mobility, patient function, and well-being. Supervised programs are more effective than individual at-home programs[38].

Pharmacologic treatment:

**NSAID`s**: NSAID`s are the foundation of treatment in AS. They are the first-line drugs in the initial management of pain and stiffness. Short tern studies of 3 months of treatment with conventional NSAID produced significant improvement in symptoms in patients with AS. There was significant improvement in spinal pain, duration of morning stiffness, night pain, immobility, stiffness, and peripheral pain[39]. The use of selective cyclooxegenase-2 inhibitors does not show an increased improvement in pain or stiffness.

Diseases modifying ant rheumatic drugs (DMARDs): They are a potential second-line therapy, but their efficacy in AS is unproven. **Sulfasalazine** has been shown to improve peripheral arthritis but not back pain. **Methotrexate**

(MTX) also has not demonstrated consistent efficacy in AS-associated back pain, but small studies show that it has a better improvement than placebos in improving scores. Leflunomide, though not very effective in improving axial pain shows improvement in peripheral arthritis.

Etanercept, infliximab and adalimumab are TNF- α antagonists approved by the US Food and Drug administration for the treatment of AS. These drugs have demonstrated rapid and sustained efficacy in the treatment of AS. Adverse reactions to TNF-α antagonists include injection site reactions, upper respiratory tract infections, and accidental injury. Rare cases of tuberculosis have been reported in patients receiving TNF-α antagonists. Infliximab and adalimumab carry a black-box warning highlighting the risk for tuberculosis. These drugs are avoided in patients with pre-existing demyelinating disease or moderate to severe heart failure.

Etanercept at 25 mg twice weekly has demonstrated consistent efficacy in a number of clinical trials in patients with AS. Studies show an improvement in patient function, spine mobility, and quality of life. Some patients experienced a partial remission after 12 weeks of Etanercept treatment. Cessation of the drug caused a relapse within 3 months[40].

Infliximab used in various studies showed consistent efficacy in patients with partial remission seen in about 20% of infliximab treated patients.

Adalimumab is under investigation for the treatment of AS. In a small 20-week study, adalimumab 40 mg every other week produced significant improvement in spinal symptoms in patients with AS. Partial remission was seen in 21.6% of patients.

Surgical options for treatment in AS are for the following:

1. Treatment of painful conditions such as arthritis of the hip or knee.
2. Providing motion in ankylosed joints.
3. Correction of deformities as in the spine.
4. Management of fractures.
5. Improvement in posture.

REVIEW OF LITERATURE

HIP INVOLVEMENT IN ANKYLOSING SPONDYLITIS

Hip involvement in AS is country dependant, affecting about 30% to 50% of patients, with the disease being bilateral in 90 % of patients[41]. It affects both joints more commonly and occurs earlier if the disease onset is earlier[42]. Hip involvement in AS can present as arthritis of the hip, fibrous or bony ankylosis. Almost 40% of patients with hip involvement in AS have bony ankylosis. The presence of ankylosis of the hips also affects the other joints such as the knee and the spine also.

The treatment of hip arthritis surgically is often postponed in young patients due to the age of the patients, but many studies show that arthroplasty has a beneficial outcome in patients. Bony ankylosis, especially when associated with a stiff spine, may present several exclusive challenges in its management. These patients are usually young and present with problems related to function, posture, and locomotion rather than pain. Hip involvement in AS has shown to increase the disease burden as well as to worsen the prognosis. Progression of spinal involvement is more prevalent in patients with hip involvement[43].

Hip function being a central and important function, hip impairment leads to a lot of disability. There is limited data on the pathophysiology and epidemiology of hip involvement in AS. In the early stages of the disease physical therapy and

pharmacological interventions can delay the progression of hip arthritis while the definitive treatment of end stage hip disease is hip arthroplasty.

Definite indications for hip arthroplasty are:

1. Ankylosis of the hips, bony or fibrous.
2. Painful arthritis of the hip joint.
3. For improvement in posture.

As mentioned earlier, management of ankylosis of the hip offers unique problems. The patients being young the demands are more as hip function is very central in nature. The problems in hip ankylosis are related to function, deformity and locomotion rather than pain, which is the most common indication for surgery in the general population. The improvement in function, and quality of life is remarkable and significant, justifying THA in patients with AS.

The problems that can arise when treating someone with AS operatively are technical in nature. Patient positioning on the operating table is difficult. Intraoperative difficulties could arise in dislocation of the hip, the presence of osteophytes and in hips that are ankylosed the neck has to be osteotomised and the acetabulum reamed with the head in situ. Intraoperative bleeding is another concern. The other problems associated with surgery in ankylosed hips is the

choice of the implants, their positioning and consideration with respect to the increased joint reaction forces in patients with significant spine stiffness.

Due importance must also be given to the deformities that are seen. The presence of external rotation deformity, exaggerated femoral anteversion and extension deformity need to be taken into consideration. Exaggerated anteversion of the hip may lead to intraoperative difficulties like impingement of the prosthetic neck or the greater trochanter posteriorly. This can be over come by using modular stems or extensively coated stems with a distal fixation. The bone is also osteoporotic and over reaming may compromise the acetabular or the femoral bone stock.

Deliberate preservation of a spike of bone in the superolateral margin of the acetabulum provided purchase for an uncemented cup as described by S Bhan et al. Tang and Chiu described the hyperextension deformity leading to a more vertically placed and anteverted cup predisposing the hip to an anterior dislocation[44].

Presence of adduction or abduction deformities tends to tilt the pelvis in the lateral position during surgery. The deformities may lead to a malpositioning of the acetabular component. Acetabular malpositioning may increase the risk of a post operative dislocation. Yong Lae Kim et al however showed that this projected high risk of post operative dislocation however does not occur

probably due to the repositioning of the greater trochanter and due to the limited range of motion post operatively. There is also no evidence that a malpositioned cup increased the polyethylene wear, osteolysis, or implant loosening. The hyperextension deformity seen in these patients is attributed to the spinal kyphosis leading to a hyperextension of the hips to improve the visual angle. Post operatively patients face difficulties such as unpredictable gain in range of motion and high incidence of ectopic bone formation and reankylosis[45].

The post operative range of motion is usually less than optimal. This poor post operative range of motion in AS can be attributed to the inactive hip muscles which are usually weak due to disuse. Understandably this range of motion is better in patients with a better pre operative range of motion than the patients with ankylosis. Other causes for a poor range of motion post operatively in patients with an ankylosis are poor muscle strength, myositis ossificans, long standing disease and the basic nature of the disease itself.

Heterotopic ossification (HO):

Rates of heterotopic ossification as high as 40%-76% have been reported in literature. The rate of developing heterotopic ossification at a second procedure if the first procedure produced heterotopic ossification is almost 4% to 61.7%. There is a risk of reankylosis with rates of 6%-10 % being shown in literature.

D J Kilgus et al showed that after an initial operation on the hip, patients who have Class-Ill or IV heterotopic bone (or, possibly, a large amount of Class-I heterotopic bone, with large fragments of heterotopic bone in the soft tissues) are at high risk for the development of a clinically important amount of heterotopic bone after a second operation on the same hip and in the contralateral hip after an operation on that hip[46]. Several patient related risk factors such as age, male sex, hypertrophic osteoarthritis, ankylosing spondylitis, diffuse idiopathic skeletal hyperostosis, and history of HO have been implicated[47]. However, soft tissue trauma is considered to be the main initiating factor for development of HO[48]. Kilgus D et al however in their study of 53 THA over a mean period of 6.3 yrs showed that having AS is in itself not a significant risk for developing HO and that other factors such as occurrence of severe HO in an earlier operated hip, infections in the hip and patients who has complete bony ankylosis preoperatively were at risk of developing significant HO[46.] When the hips are ankylosed preoperatively, the patient may also be at increased risk. Any form of prophylaxis be it NSAIDS or radiation have their own side effects and the choice of prophylaxis should be chosen keeping in mind the risks and benefits. As it is possible to identify patients who are more predisposed to formation of HA it would be better to limit prophylaxis to such patients.

In patients with bilateral involvement it is observed that operating both hips at the same time is more beneficial functionally than staging the surgery into two parts. This is explained by the fact that the deformity in the un-operated side undermines the functional benefit gained by the operated side.

Deformities of the spine also need to be addressed if they contribute to the functional disability. Kyphotic deformities of the spine are seen in AS. Prior to correction of the spine deformity the hip flexion deformity has to be corrected and if a flexion deformity continues to persist then the spinal deformity needs to be corrected.

Arthroplasty in ankylosing spondylitis:

Cemented or Uncemented: The decision to use cemented or uncemented largely remains with the surgeon. There are numerous studies which show that both cemented as well as uncemented arthroplasty produce comparable results. However surgeons prefer uncemented arthroplasty in younger individuals as the bone stock is better and the bony ingrowth in uncemented arthroplasty being preferable to the cemented implant. In comparing cemented with uncemented in patients with AS, cemented acetabular cups showed a higher incidence of lucencies in the bone cement interface as described by Kilgus et al[46]. Joshi et al in a study of 181 hips with a follow up of 27 yrs showed excellent pain relief in about 97% of the patients and excellent hip function in about 65%[49]. Bhan S et

al retrospectively reviewed 54 patients and 92 hips treated with uncemented arthroplasty and showed that the results were good[50]. Brinker M et al in a study of 20 uncemented hips followed up over a period of 75 months showed a good outcome in his results. The results when compared with other series of cemented arthroplasty did not show a significant difference in outcomes[51].

In AS most of the patients requiring arthroplasty are of the younger age group and more of the recent studies show a preference to uncemented implants and articular surface replacement.

Articular surface replacement (ASR): Articular surface replacement provides the advantage of a larger range of motion with a greater stability. This is useful as patients can be mobilized early reducing the occurrence of post operative stiffness or reankylosis which is common in patients with AS. The other advantages in using ASR is that AS being more common in younger patients who have good bone stock, this technique preserves the femoral bone stock, it increases stability, further improves the biomechanics and loading properties and easy conversion to a formal THA if needed. Early mobilization of the hip can be attempted as the hip is very stable and early mobilization prevents stiffness. Thus ASR is beneficial in the younger patient. There is however a dearth of literature on long term outcomes in ASR.

Disadvantages of ASR are in the incidence of metallosis in metal on metal bearing surfaces and is a significant problem especially in women of child bearing age group. Another disadvantage is the cost.

Technical problems arise during surgery in patients with AS who have bony ankylosis or severe arthritis in which cases it becomes very difficult to dislocate the hip. A bony ankylosis is a contraindication for ASR. However an isolated study by Jia Li et al describes the procedure the followed for ASR in patients with AS even in the presence of bony ankylosis. The joint is isolated by removing the ankylosis and dislocated before the articular resurfacing could be attempted. It is technically demanding and requires precision in isolating the normal anatomical hip rotation centre in an ankylosed joint.

Krishna Reddi B S R et al showed that there is a significant increase in the incidence of heterotopic ossification in ASR possibly due to a larger tissue dissection[52]. Cuckler et al compared heads of diameters 28mm and 32 mm and showed that the head with a larger diameter had a better range of motion, thereby showing that the range of motion improvement in ASR would be significant[53].

There is a dearth of literature on ASR in patients with AS and results of ASR done on patients with osteonecrosis have to be considered.

Jia Li et al has shown that ASR in young AS patients has the advantage of a good range of motion, early mobilization, low dislocation rate and an easier conversion to a total hip arthroplasty[54].

Hemiarthroplasty: Bipolar hemiarthroplasty, though not described vastly in literature has been shown by Bhan S et al[55].to be effective in patients with AS. He advocates the use of the bipolar implants in patients with either bony or fibrous ankylosis as the acetabulum created from a bed of cancellous bone from the ankylosis may not be suitable for acetabular fixation. Moreover he shows that there were no cases of HO in his series attributing it probably to the shorter operating time, less extensive surgery, less bleeding or haematoma formation, minimal soft-tissue dissection and the fact that the greater trochanter was not detached in any case.

Furthermore as the greatest movement in a bipolar prosthesis occurs at the inner bearing, this significantly diminishes the reaction from tissue friction and possibly protects against the development of heterotopic ossification.

In addition the self aligning cup in the bipolar prostheses is more suitable in patients where excessive ankylosis makes it difficult to orient the implant in the correct direction.

Spine involvement in ankylosing spondylitis:

Spine involvement in AS is very relevant due to the associated effects of a deformed spine on the hip in terms of function, range of motion and joint reaction forces. In severe AS there is a fusion of the spine and a resulting kyphosis develops, probably attributed among other things to the habit of using pillows under the neck.

As the kyphosis progresses and becomes severe there is a gradual drop in the horizon and the visual axis is sometimes perpendicular to the ground. In such cases it becomes very difficult for the patient to be functionally independent. The deformity is further compounded by a stiff or ankylosed hip. The patient also develops severe thoracic and abdominal pain.

The patients are also predisposed to develop fractures of the vertebrae.

Only recently has osteoporosis been identified as a major risk factor for the occurrence of fractures. The presence of osteoporosis of the femoral neck with a relatively larger amount of osteoporosis of the posterior spine as compared with the anterior spine shows that inflammation is the cause for the decreased bone mineral density[23].

The presence of a low bone density with a rigid spine with a poor tolerance to stresses is susceptible to fractures even with forces of low intensity.

Neurological complications also occurred with lower intensity forces rather than high energy trauma.

Wedge osteotomies for the spine were described first by Smith Petersen, Larsson & Aufranc in 1945. Later La Chapelle (1946) and Herbert (1955) corrected deformities of the spine in two stages. Briggs, Keafs & Schlesinger (1947), Law (1949) and Adams (1952) preferred immediate correction on the operating table as well as fusion. Karel Styblo et al in a series of 22 patients conducted corrective osteotomies on the spine. They advocate a correction of about 40°-50° of compensatory lumbar lordosis at either L2-L3 or L4-L5 which are considered safe levels.

Functional assessment in patients with AS:

Ankylosing spondylitis affects patients in every aspect of their life. The patients are affected by the disease itself, its systemic manifestations and the deformities that result from the disease. They are sometimes so crippled by the disease that they are completely dependant on their family members for their activities of daily living.

Assessment of a patients with AS cannot be restricted to one or two domains but must assess various aspects of the disease. This has led to the development of patient assessed health instruments which measure the health related quality of life in theses patients. These health instruments are in the form of

questionnaire involving specific questions which may be in the form of a set of choices or a visual analogue scale. Some of the more popular indices that assess the patient are the Bath indices and the Dougados functional index. A review of all theses patient assessed health instruments showed that the Bath Ankylosing Spondylitis Disease Activity Index (BASDAI), the Bath Ankylosing Spondylitis Functional Index (BASFI) and the Dougados Functional Index (DFI) had the greatest amount of evidence for reliability, validity and responsiveness across a range of settings[56]. The BASFI was shown to be a better scoring system in terms of distribution, reproducibility and reliability by Calin et al when compared with the Dougados functional index.

MATERIALS AND METHODS

This is a retrospective study where all patients with ankylosing spondylitis who fit into the Modified New York criteria, with painful arthritis or ankylosis of the hip and who underwent primary hip arthroplasty between January 2005 and June 2009 were included in the study. Exclusion criteria for this study were:

1. Patients with spondyloarthropathy or with any form of inflammatory arthritis who did not fit into the Modified New York criteria.
2. Patients who underwent revision surgery.

A total of 45 patients were identified for the study based on the operation theatre register, inpatient and outpatient records. Correspondence was sent to their latest known addresses inviting them to participate in the study. Contact numbers were used when available. The mean duration of follow up in this study was 15.44 (3-52) months. This study was conducted in the department of Orthopaedics, Christian Medical College, Vellore between June 2008 and August 2009.

The study was approved by the ethics committee of the hospital.

Of the 45 patients reviewed, 24 patients responded. Of the 21 patients who could not be included in the study, 10 had come for follow up prior to the period in which the study was conducted and did not come for any further follow up. 11 of them never came for follow up after surgery. As the patient's

response was required in the form of answering questionnaires and being present for a clinical assessment, these 21 patients could not be included in the study. However the 10 patients who had come for follow up prior to the period of the study were assessed based on the documentation from their out patient records and all ten of them were reported to be ambulant and were doing well in terms of their function. There was no documentation of any adverse outcomes in these patients as recorded in their out patient records at follow up.

The 24 patients who came for follow up were interviewed on a personal basis. Informed consent was taken. Interviews were conducted for obtaining the relevant history and applying the questionnaires.

Functional assessment of the patients was done using two scores: The Harris hip score and the Bath ankylosing spondylitis functional index. Clinical examination was done to assess the range of movement of the hip or hips. Radiographs taken at the time of follow up were used to assess the presence and grade of heterotopic ossification. The classification system described by Brooker et al was used to classify the HO.

PATIENT DEMOGRAPHY

Of the 24 patients who were included in the study, 22(91.6%) were men and 2(8.3%) were women. The mean age of the patients was 37.16 yr (18-62).

12(50%) patients had bilateral hip arthroplasty and 12(50%) unilateral.

Of the 36 hips operated 18(50%) were on the left side and 18(50%) on the right side.

Of the 24 patients, 13(54.2%) patients underwent cemented arthroplasty, 5(20.8%) underwent uncemented arthroplasty and 6(25%) underwent articular surface replacement. Of the 36 hips operated, 20(55.6%) underwent cemented arthroplasty, 5(13.8%) underwent uncemented arthroplasty and 11(30.6%) underwent articular surface replacement.

The mean age of patients undergoing cemented arthroplasty was 41.1 yrs, in patients undergoing uncemented arthroplasty it was 32.2 yrs and in patients undergoing articular surface replacement it was 32.27 yrs. 13(54.16%) patients and 17(47.22%) hips had bony ankylosis. 16 0f the 24 patients received prophylaxis for heterotopic ossification in the form of oral Indomethacin.

Table 2: Patient demography

	Patients	Hips
Total patients	**24**	**36**
Male n (%)	**22 (91.6%)**	**34 (94.4%)**
Female n (%)	**2 (8.3%)**	**2 (5.5%)**
Left side n (%)	**12 (50%)**	**18 (50%)**
Right side n (%)	**12 (50%)**	**18 (50%)**
Bilateral n (%)	**12 (50%)**	**-**
Bony ankylosis n (%)	**13 (54.16%)**	**17 (47.22%)**

OPERATIVE PROCEDURE

All patients who were planned for surgery were seen and evaluated initially in the out patient department and were admitted 1 to 2 days prior to the day of surgery. They were thoroughly examined and clerked by the junior residents. Surgeries were done by two surgeons with vast experience in arthroplasty. The surgeries were performed either in the supine or lateral positions.

The approaches used were:

1. Posterior Moore approach in lateral position.
2. Modified Hardinge Lateral approach in supine/lateral position.
3. Lateral approach with trochanteric osteotomy in lateral position.

All patients were administered preoperative prophylactic IV antibiotics. None of the patients received any form of thromboembolic prophylaxis.

16 of the 24 patients received prophylaxis for heterotopic ossification in the form of oral Indomethacin. Patients undergoing cementing underwent second generation cementing technique. Wounds were close with suction drains and an abduction pillow was placed between the legs in the immediate post operative period itself.

The patients were shifted into a special arthroplasty room for the first 48 hrs following surgery. Thromboembolic prophylaxis was started on the night of surgery itself in the form of mechanical prophylaxis such as ankle-pump

exercises, calf muscle squeezing and sequential compression device. All patients followed a physical therapy regimen starting on the first postoperative day when they started isometric knee extension and hip abduction exercises. Drains were removed two days after surgery and radiographs were taken. Intravenous antibiotics were continued at least till drain removal and then changed to oral antibiotics depending on the surgeon's preference.

Full weight-bearing ambulation with bilateral axillary crutches was started after X-rays 48 hours following surgery. Patients with bilateral total hip replacements were initially ambulated full weight-bearing with a walker and gradually progressed to crutch walking. During the post operative period they were taught a home program to be followed at home following discharge. Suture removal was done on the 10^{th} post operative day and they were restarted on any DMARDs they were on.

They were advised follow up at 3 months.

ASSESSMENT OF FUNCTIONAL OUTCOME

Patients were assessed functionally with two scores.

1. Harris Hip Score
2. Bath Ankylosing Spondylitis Functional Index (BASFI)

The Harris hip score assessed the patient in four domains

1. Pain – 44 points
2. Function – 47 points

   Gait – 33 points

   Activities of daily living – 14 points.

4. Absence of deformity – 4 points
5. Range of motion – 5 points.

A total score of 90-100 was considered as excellent, 80-89 good, 70-79 fair and below 70 poor. The BASFI is a set of 10 questions each answered in the form of a visual analogue scale marked between 0 to 10, 0 being easy and 10 being impossible. The first 8 questions considered activities related to functional anatomy. The last 2 questions relate to the patients ability to cope with everyday life. The score was totaled and divided by ten. A score closest to zero was the best possible score. Patients were asked to answer the questions and fill out the forms at follow up. The pre operative scores were taken at the time of follow up as the study was retrospective in nature. The pre operative range of motion was assessed from the old inpatient charts or the discharge summaries. The patients were clinically examined to assess the range of motion and any deformities if present.

Other parameters that were compared were pre and post operative improvement in range of motion, pain score using the Harris hip score.

Radiological assessment was made at the time of follow up to assess any ectopic bone formation. The assessment of ectopic bone formation was done using the classification described by Brooker et al[57].

Table 3: Brookers classification of ectopic calcification

Class 1	**Islands of bone within the soft tissues about the hip**
Class 2	**Bone spurs from the pelvis or proximal end of the femur, leaving at least one centimeter between opposing bone surface**
Class 3	**Bone spurs from the pelvis or proximal end of the femur, reducing the space between opposing bone surfaces to less than one centimeter**
Class 4	**Apparent bone ankylosis of the hip**

Additional surgeries: One patient underwent adductor tenotomy, while three patients underwent adductor tenotomy, Souttars release and Yount`s release.

One patient at follow up underwent bilateral total knee arthroplasty for a bilateral 30° fixed flexion deformity.

RESULTS

The scores were analyzed using SPSS 12.0® software for Windows®.

All patients experienced a substantial clinical improvement in terms of pain, function and range of motion. At a mean follow up of **15.44** months (3 to 52 months), the mean pre operative Harris hip score improved from **30.89**/100 (SD of 19.58; range 2-73) to **82.63**/100 (SD of 7.816; range 57-96) at the time of follow up. This was statistically significant ($p<0.05$).

The mean preoperative BASFI score improved from **7.51**/10 (SD of 1.445; range of 4.2-9.4) to **3.93**/10 (SD of 1.372; range of 1.4-6.7) at the time of follow up. This was statistically significant ($p<0.05$).

The mean pre operative Harris hip score improved from **28.9**/100 (SD of 20.013; range of 2-73) to **83**/100 (SD of 6.989; range of 71-96) in the cemented group, **33**/100 (SD of 23.484; range of 5-58) to **76.4**/100 (SD of 12.462; range of 57-91) in the uncemented group and **33.27**/100 (SD of 18.553; range of 8-57) to **84.82**/100 (SD of 5.828; range of 75-92) in the ASR group. This was statistically significant ($p<0.05$).

The average BASFI score improved from **7.48**/10 (SD of 1.313; range of 4.6-9.2) to **4.06**/10 (SD of 1.451; range of 2.5-6.4) in the cemented group, **6.96**/10 (SD of 1.957; range of 4.2-8.4) to **4.56**/10 (SD of 1.27; range of 3-4.4) in the uncemented group and **7.83**/10 (SD of 1.494; range of 6.6-9.4) to **3.42**/10 (SD

of 1.191; range of 1.4-6.1) in the ASR group. This was statistically significant ($p<0.05$).

The pain score improved from **13.72** out of 44 pre operatively to **42.05** out of 44 postoperatively. This was statistically significant ($p<0.05$).The average preoperative pain score improved from **14.2** to **42.4** in the cemented group, **12** to **38.8** in the uncemented group and from **13.64** to **42.91** in the ASR group. This was statistically significant.

At follow up 21(58.33%) hips were completely pain free, 14(38.9%) hips had slight to occasional pain and 1(2.77%) hip had mild pain. 7(19.44%) hips showed an excellent outcome, 20(55.56%) hips showed a good outcome and 9(25%) hips showed a fair outcome using the Harris hip score.

The average preoperative range of motion improved from **32.5**° (0°-135°) to **184.3**° (110°-280°) at follow up. This was statistically significant ($p<0.05$). The average gain in range of motion was **151.8**° (15°-210°). The average preoperative range of motion improved from **15**° to **177**° in the cemented group, **35**° to **176**° in the uncemented group and from **63**° to **200** ° in the ASR group. This was statistically significant ($p<0.05$).

Ectopic bone formation was observed in 7 hips with Grade 1 in 6 hips and Grade 2 in one hip.

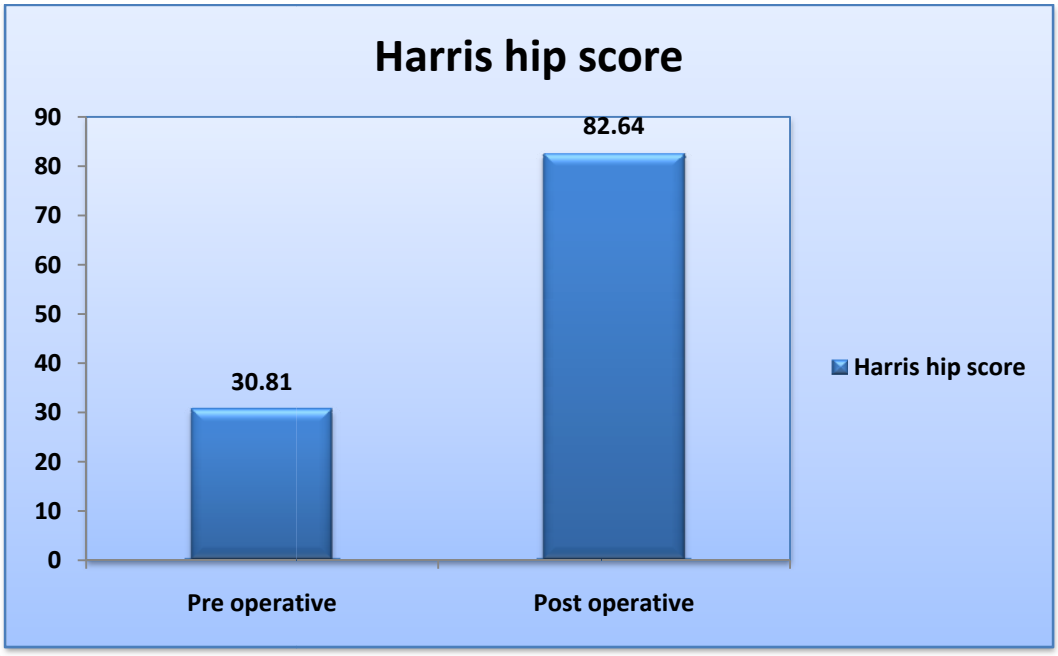
The Harris hip score, BASFI, range of motion and pain scores were compared within the cemented, uncemented and ASR groups and it was found that there was no significant difference between the groups.

Two groups of patients, those who underwent bilateral hip surgery at one sitting and those that underwent bilateral hip surgery in two stages were also compared and the Harris hip score improved from **28.14** to **84.85** in the first group and from **38.4** to **84.5** in the second group. The BASFI score improved from **7.8** to **3.5** in the first group and from **7.24** to **4.33** in the second group. The range of motion improved from **38.21**° to **174.28**° in the first group and from **33.5**° to **195**° in the second group. The pain score improved from **13.14** to **42.28** in the first group and from **17** to **42.8** in the second group. There was no significance in the improvement in the scores between the two groups.

Complications: One patient developed chicken pox during the post operative period and received oral Acyclovir. He had an uneventful recovery. Three patients were already on anti tubercular treatment for pulmonary tuberculosis at the time of surgery. There were no other complications.

Table 4: The Harris hip score

	Harris hip score
Pre operative	30.81
Post operative	82.64

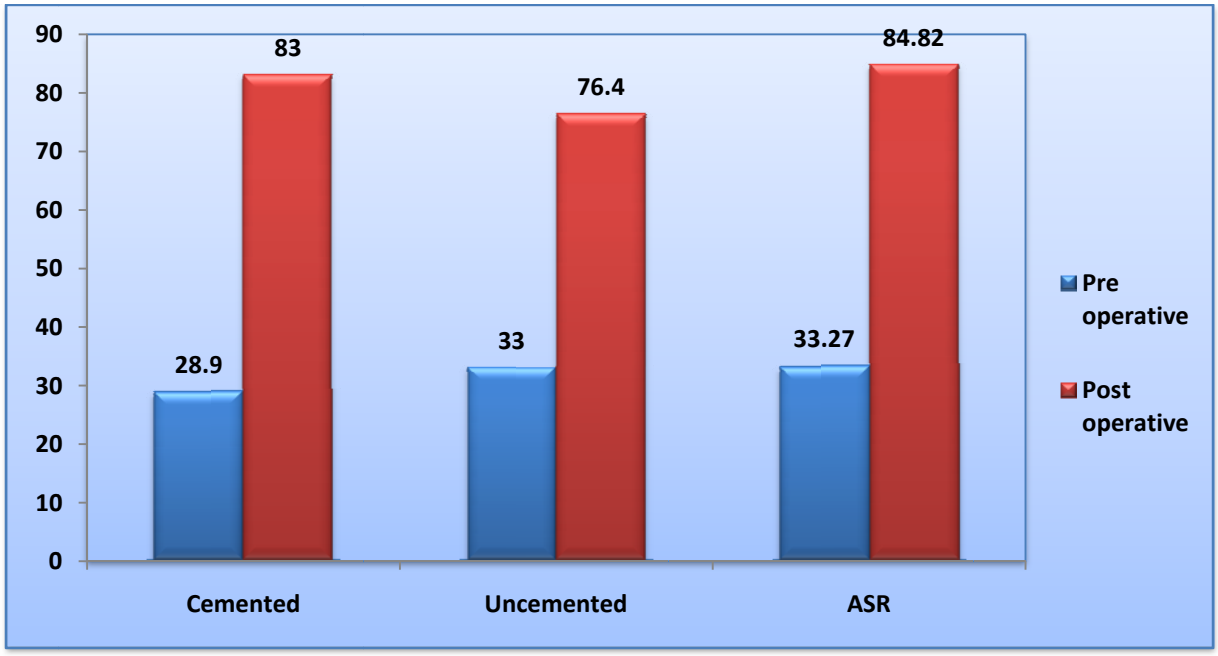


Paired Samples Test

	Paired Differences					t	df	Sig. (2-tailed)
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference Lower	Upper			
Harris hip score pre op - Harris hip score post op	-51.833	18.775	3.129	-58.186	-45.481	-16.565	35	.000

Table 5: Harris hip score comparing implants

Harris hip score	Cemented	Uncemented	ASR
Pre operative	28.90	33	33.27
Post operative	83	76.40	84.82

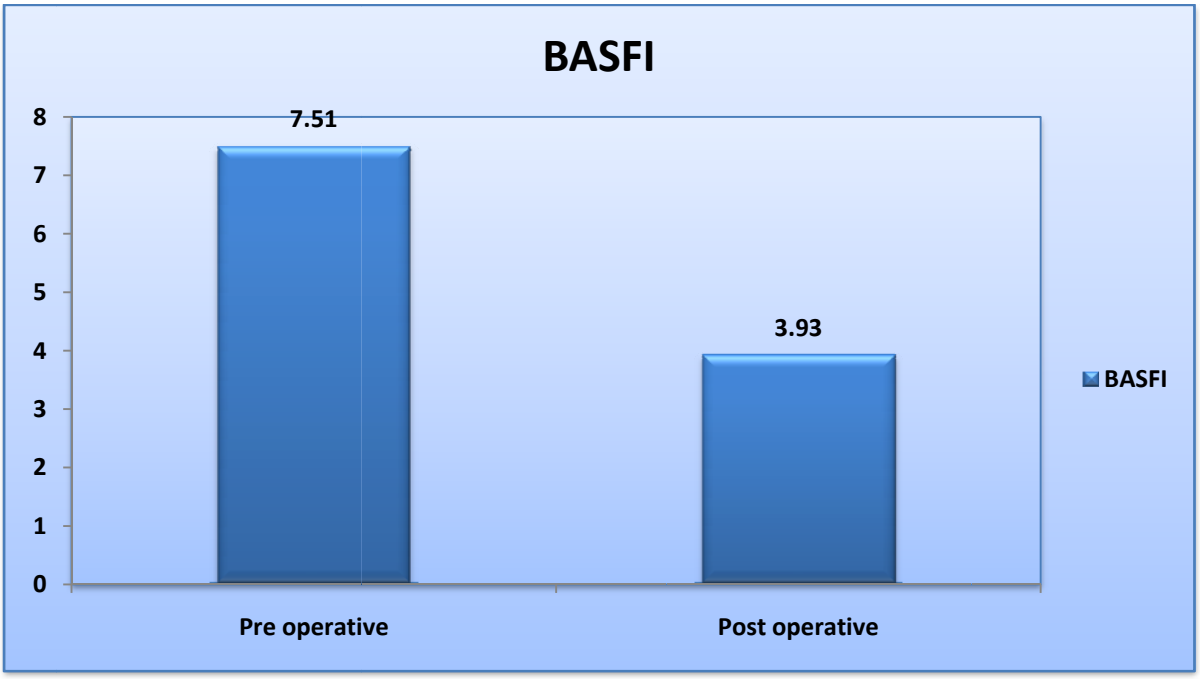


Paired Samples Test

	Paired Differences					t	df	Sig. (2-tailed)
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference Lower	Upper			
Cemented	-54.100	16.908	3.781	-62.013	-46.187	14.309	19	.000
Uncemented	-43.400	29.022	12.979	-79.436	-7.364	-3.344	4	.029
ASR	-51.545	17.541	5.289	-63.329	-39.762	-9.746	10	.000

Table 6: BASFI

	BASFI
Pre operative	7.51
Post operative	3.93

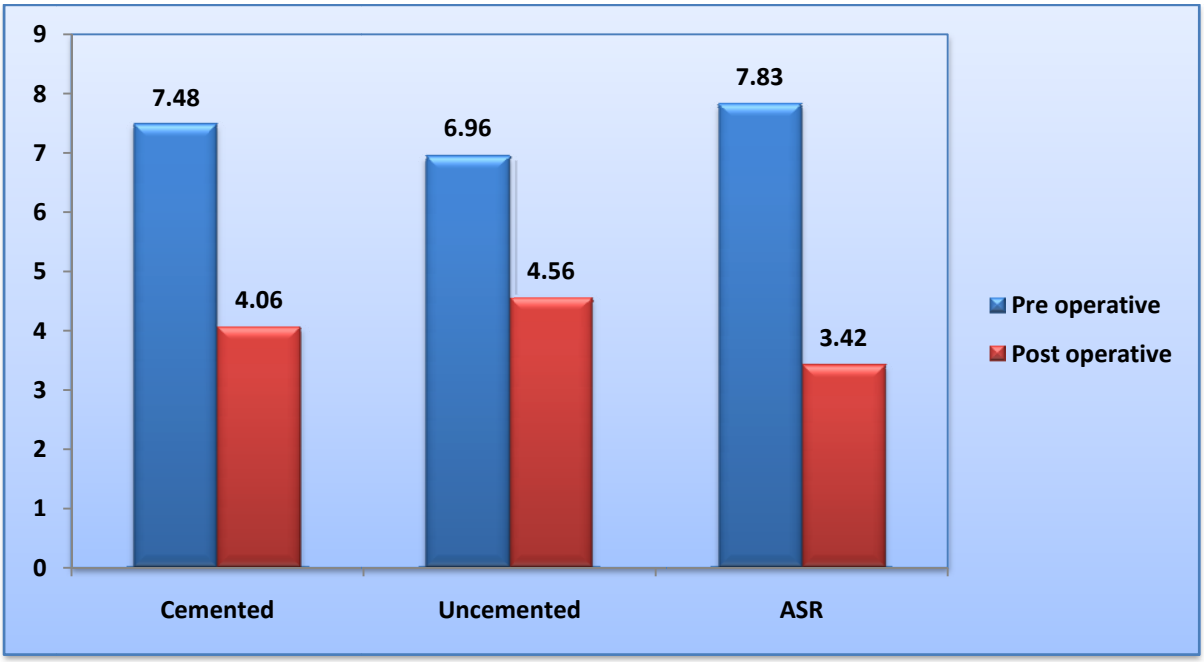


Paired Samples Test

	Paired Differences					t	df	Sig. (2-tailed)
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference Lower	Upper			
BASFI pre-BASFI post	3.581	1.632	.272	3.028	4.133	13.163	35	.000

Table 7: BASFI scores comparing implants

	Cemented	Uncemented	ASR
Pre operative	7.48	6.96	7.83
Post operative	4.06	4.56	3.42

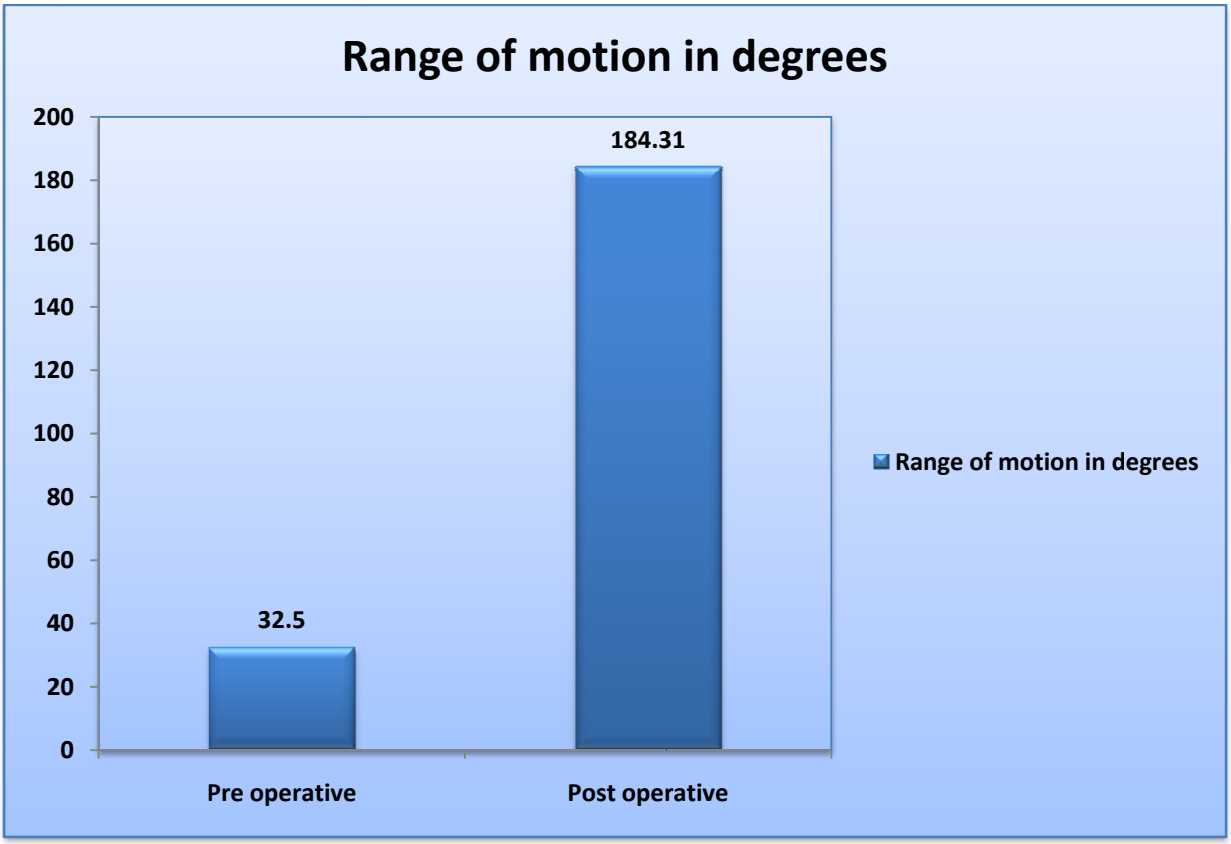


Paired Samples Test

	Paired Differences					t	df	Sig. (2-tailed)
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference Lower	Upper			
Cemented	3.420	1.348	.301	2.789	4.051	11.348	19	.000
Uncemented	2.400	1.840	.823	.116	4.684	2.917	4	.043
ASR	4.409	1.736	.524	3.243	5.576	8.422	10	.000

Table 8: Range of motion

	Range of motion in degrees
Pre operative	32.50
Post operative	184.31

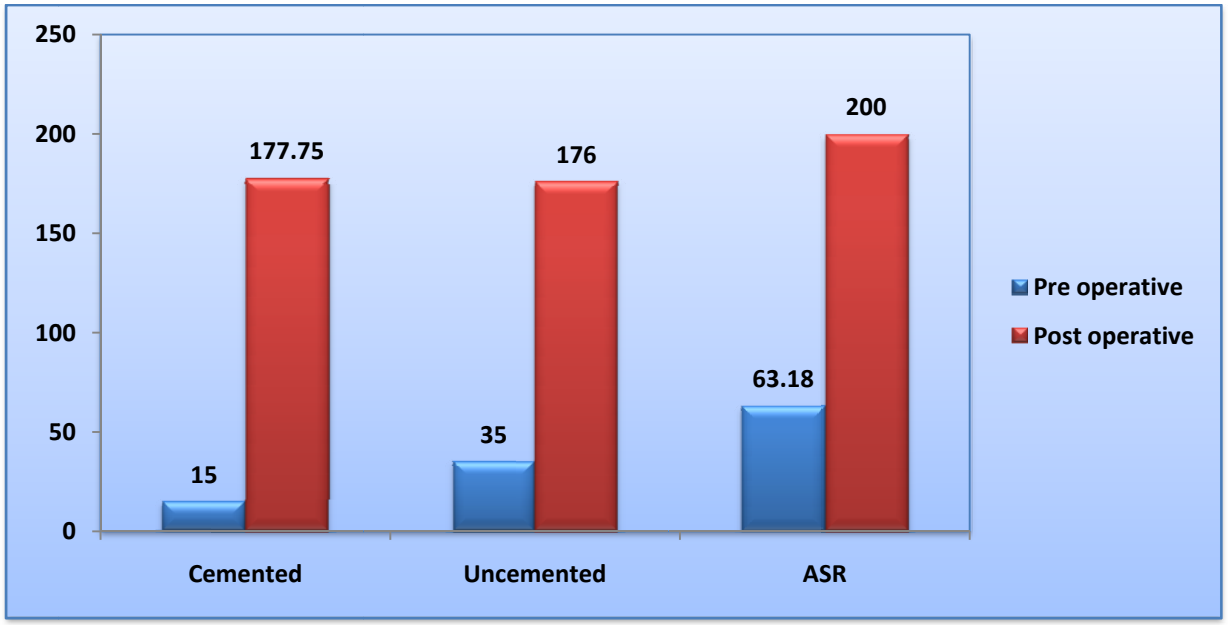


Paired Samples Test

	Paired Differences					t	df	Sig. (2-tailed)
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference Lower	Upper			
ROM pre op – ROM post op	-151.806	46.061	7.677	-167.390	-136.221	-19.774	35	.000

Table 9: Range of motion in degrees comparing implants

	Cemented	Uncemented	ASR
Pre operative	15	35	63.18
Post operative	177.75	176	200

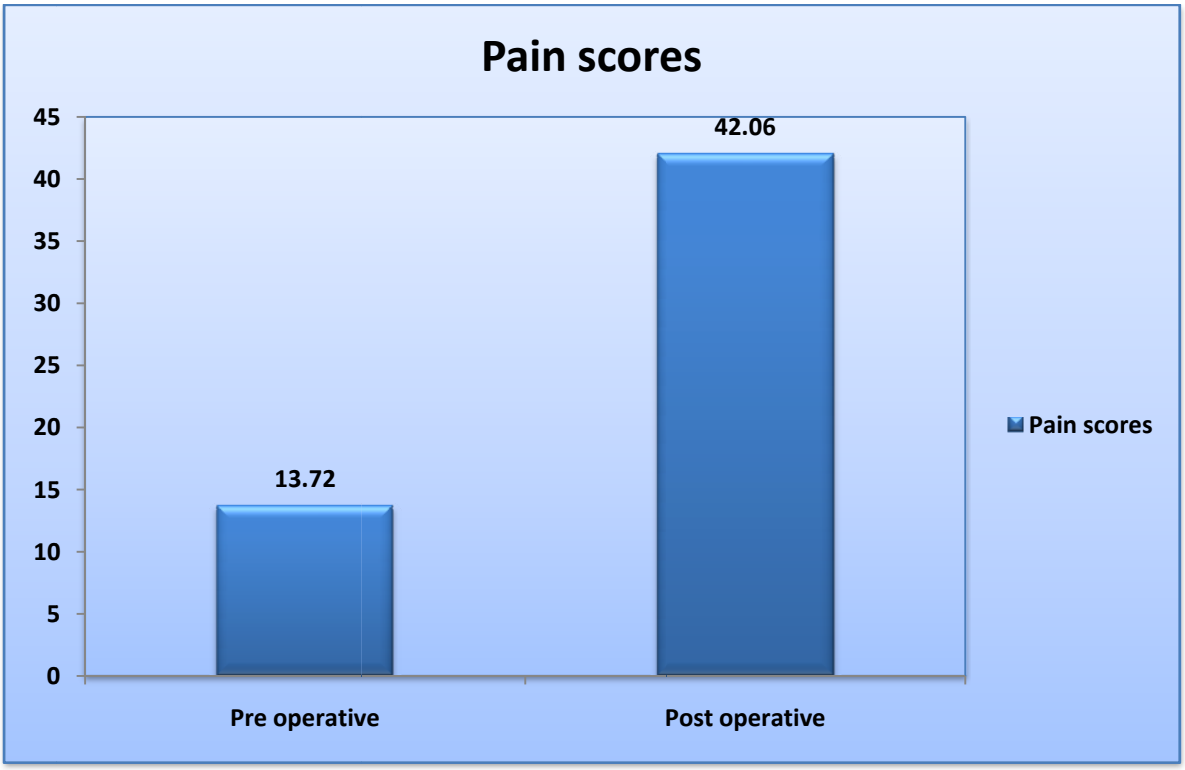


Paired Samples Test

	Paired Differences					t	df	Sig. (2-tailed)
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference Lower	Upper			
Cemented	-162.750	30.542	6.829	-177.044	-148.456	-23.831	19	.000
Uncemented	-141.000	48.010	21.471	-200.613	-81.387	-6.567	4	.003
ASR	-136.818	64.702	19.508	-180.286	-93.351	-7.013	10	.000

Table 10: Pain scores

	Pain scores
Pre operative	13.72
Post operative	42.06

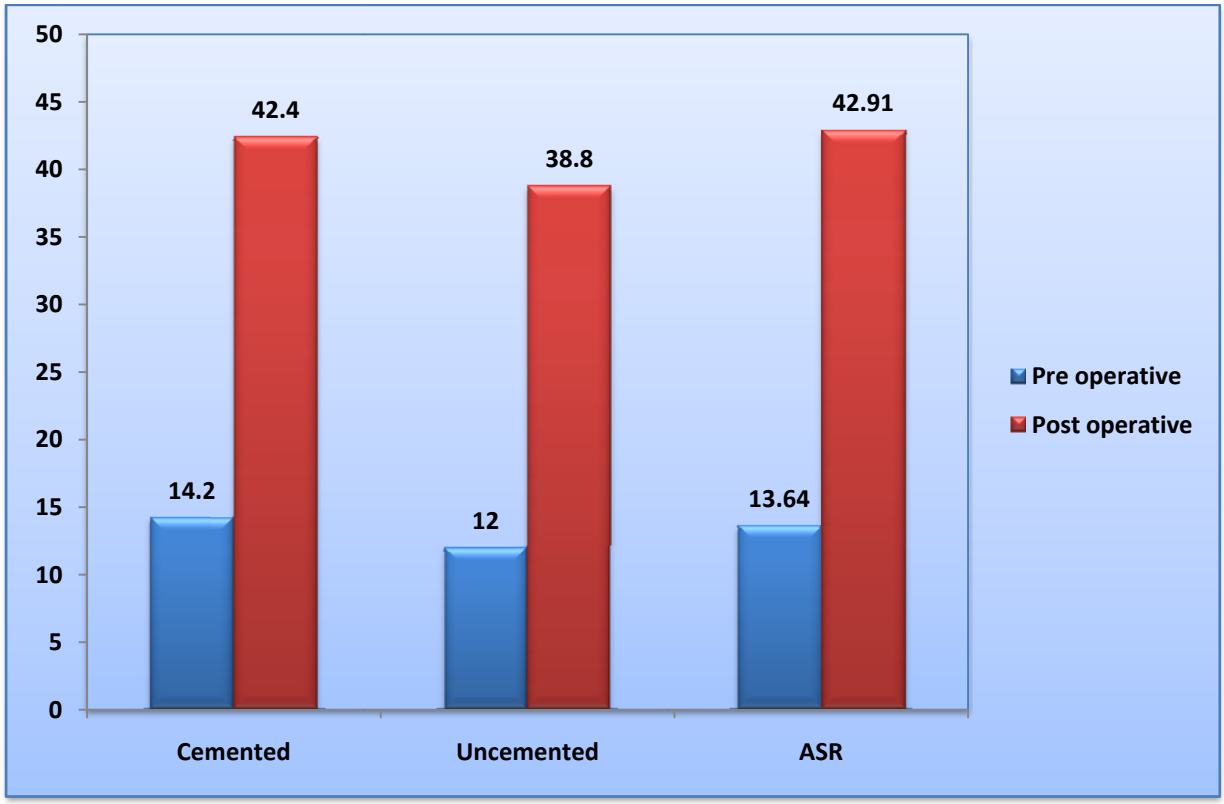


Paired Samples Test

	Paired Differences					t	df	Sig. (2-tailed)
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference Lower	Upper			
pain pre - pain post	-28.333	10.556	1.759	-31.905	-24.762	-16.105	35	.000

Table 11: Pain scores comparing implants

	Cemented	Uncemented	ASR
Pre operative	14.20	12	13.64
Post operative	42.40	38.80	42.91



Paired Samples Test

	Paired Differences					t	df	Sig. (2-tailed)
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference Lower	Upper			
Cemented	-28.200	11.768	2.631	-33.708	-22.692	-10.717	19	.000
Uncemented	-26.800	10.545	4.716	-39.894	-13.706	-5.683	4	.005
ASR	-29.273	8.956	2.700	-35.290	-23.256	-10.840	10	.000

Table 12: Comparing within the cemented, uncemented and ASR groups:

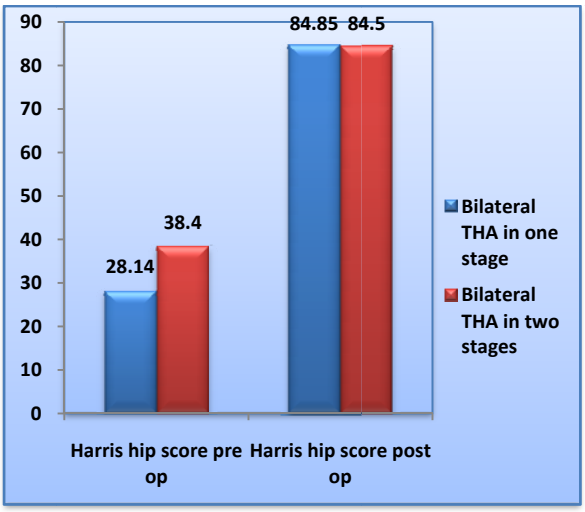
ANOVA						
		Sum of Squares	df	Mean Square	F	Sig.
Harris hip score post op	Between Groups	249.469	2	124.735	2.179	.129
	Within Groups	1888.836	33	57.237		
	Total	2138.306	35			
BASFI post op	Between Groups	5.179	2	2.589	1.408	.259
	Within Groups	60.678	33	1.839		
	Total	65.856	35			
Range of motion post op in degrees	Between Groups	3913.889	2	1956.944	2.087	.140
	Within Groups	30943.750	33	937.689		
	Total	34857.639	35			
pain post op	Between Groups	63.380	2	31.690	4.743	.015
	Within Groups	220.509	33	6.682		
	Total	283.889	35			

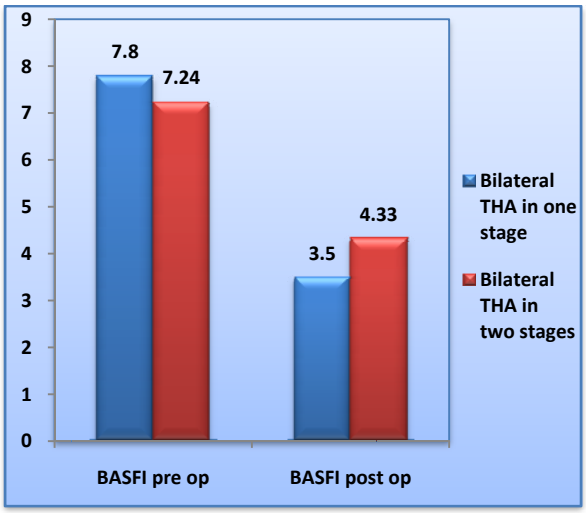
Table 13: Comparing pain scores within the groups:

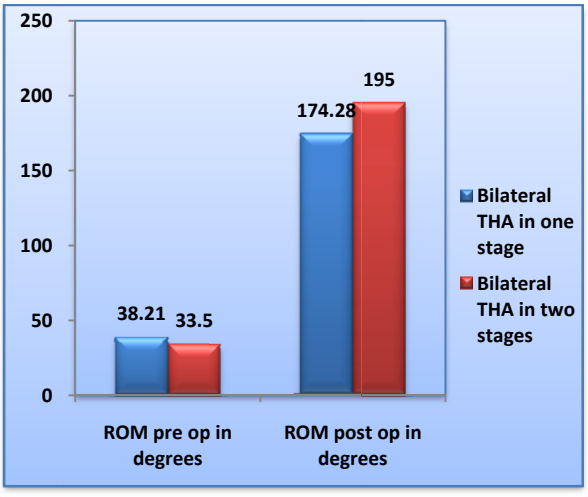
Multiple Comparisons Dependent Variable: pain post Bonferroni						
		Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
(I) SURGERY	(J) SURGERY				Lower Bound	Upper Bound
Cemented	Uncemented	3.60(*)	1.292	.026	.34	6.86
	ASR	-.51	.970	1.000	-2.96	1.94
Uncemented	Cemented	-3.60(*)	1.292	.026	-6.86	-.34
	ASR	-4.11(*)	1.394	.018	-7.63	-.59
ASR	Cemented	.51	.970	1.000	-1.94	2.96
	Uncemented	4.11(*)	1.394	.018	.59	7.63
* The mean difference is significant at the .05 level.						

Table 14: Comparing one and two stage operated bilateral hip patients:

	Harris hip score pre op	Harris hip score post op	BASFI pre op	BASFI post op	ROM pre op in degrees	ROM post op in degrees	Pain pre op	Pain post op
Bilateral THA in one stage	28.14	84.85	7.8	3.5	38.21	174.28	13.14	42.28
Bilateral THA in two stages	38.4	84.5	7.24	4.33	33.5	195	17	42.8







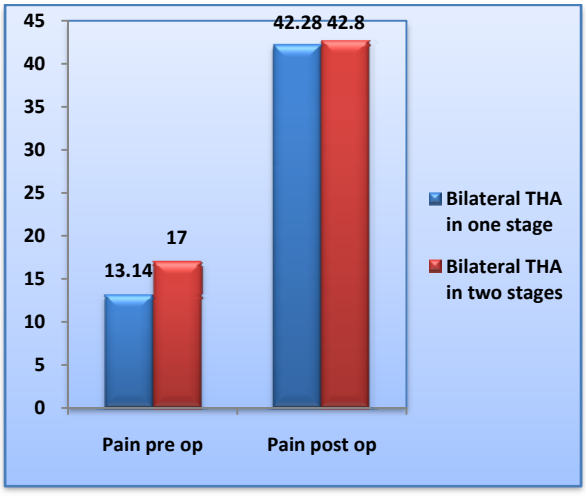


Table 15: Group Statistics

	GROUP	N	Mean	Std. Deviation	Std. Error Mean
Harris hip score	One stage	14	84.86	7.199	1.924
	Two stage	10	84.50	5.191	1.641
BASFI	One stage	14	3.500	1.0138	.2709
	Two stage	10	4.330	1.5671	.4955
Range of motion	One stage	14	174.29	25.333	6.771
	Two stage	10	195.00	41.966	13.271
Pain score	One stage	14	42.29	2.054	.549
	Two stage	10	42.80	1.932	.611

Comparing one and two stage operated bilateral hip patients

Table 16: Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Harris hip score	Equal variances assumed	1.898	.182	.134	22	.895	.36	2.672	-5.184	5.898
	Equal variances not assumed			.141	21.987	.889	.36	2.529	-4.888	5.602
BASFI	Equal variances assumed	2.955	.100	-1.579	22	.129	-.830	.5257	-1.9202	.2602
	Equal variances not assumed			-1.470	14.300	.163	-.830	.5648	-2.0389	.3789
Range of motion	Equal variances assumed	1.900	.182	-1.509	22	.146	-20.71	13.730	-49.189	7.760
	Equal variances not assumed			-1.390	13.655	.187	-20.71	14.898	-52.743	11.315
Pain scores	Equal variances assumed	1.540	.228	-.619	22	.542	-.51	.830	-2.236	1.207
	Equal variances not assumed			-.626	20.257	.538	-.51	.821	-2.226	1.198

Comparing one and two stage operated bilateral hip patients

Discussion

Total hip arthroplasty has been shown to be one of the most rewarding surgeries in orthopaedics in terms of patient function, pain relief, stability and range of motion. There has been a lot of concern in THA in patient with AS as the average patient with AS is very young. Several reports are present in literature showing that there is improvement in hip function and patient satisfaction after THA. Current literature has progressed from earlier studies which focused on smaller patient numbers and the use of cemented arthroplasty to studies that have larger patient numbers and larger duration of follow up[42,44,46,49,50]. The use of cementless and even articular surface replacement has been studied[50,51,55]. Specific studies on patients with ankylosis of the hips and surgery on bilateral hips also have been documented and have shown significant improvement in function, pain relief and range of motion[50,58]. The specific problems faced when considering arthroplasty in patients with AS is the age of the patient and the presence of ankylosis of the joint for which the patient may actually present without any pain. There is a risk of HO, stiffness, reankylosis and other complications.

A review of literature showed that a lot of work has been done in arthroplasty in patients with ankylosing spondylitis

Table 17: Summary of studies in literature on arthroplasty in AS:

Year	Authors	No of patients	No of hips	follow up yrs
1970	Welch and Charnley	20	31	2.6
1972	Arden et al	10	14	>1?
1976	Bisla et al	23	34	3.5
1977	Williams et al	53	86	3
1977	Baldursson et al	10	18	3.8
1982	Shanahan et al	12	16	7.4
1987	Toni et al	22	28	2-14
1988	Finsterbush et al	23	35	8
1989	Calin and Elswood	87	138	7.5
1990	Kilgus et al	31	53	6.3
1991	Walker and Sledge	19	29	4.6
1995	Shih et al	46	74	8.3
1996	Brinker et al	12	20	6.2
1996	Bhan and Malhotra	12	19	3.8
1997	Sochart and Porter	24	43	22.7
2000	Tang and Chiu	58	95	11.2
2001	Joshi et al	103	181	10.3
2007	Yong Lae Kim et al	12	24	>3
2008	Surya Bhan et al	54	92	8.5
2009	Jia Li et al	24	39	2

Clinical results:

The results of this study are in the acceptable range for successful outcome after arthroplasty. The Harris hip score improved from 30.8 to 82.6 with an improvement of 51.8 points and showed a significant clinical result ($p<0.05$). This is comparable to Brinker M et al who showed a 40.7 point improvement in the Harris hip score(48.4 to 89.1)[51]. 27(75%) hips showed a good to excellent outcome which is comparable to earlier studies such as Williams's et al (73% excellent outcome) with 86 cemented arthroplasties[59]. Calin and Elswood reported 86% good or very good results in 138 primary and 12 revision hips[2]. Bisla et al showed a 91% good clinical report of 34 cemented hips[60]. Joshi et al reported that their series of follow up scores showed on a 65% excellent while 96% showed excellent pain relief. They attributed it to the advanced age at follow up[49].

Our study also showed an improvement in the BASFI score with an improvement from 7.51 to 3.93 with 0 being the best possible score. This was a significant improvement in the function of the patient as a whole ($p<0.05$). The BASFI score has never been used in the earlier mentioned studies (table 17). It is a score predominantly used in assessing progress of treatment in patients on medical and physical therapy. Since AS affects the person as a whole and a surgery such as a THA can provide a significant functional improvement the

BASFI score was used in our study and clearly shows an improvement in the scores. An improvement in the BASFI score also suggests that THA may not just benefit the patients function as related to the hip alone but as a person on the whole. BASFI has been described as having the greatest amount of evidence for reliability, validity and responsiveness across a range of setting for assessing a patient's health[56]. The above results clearly show that THA provides the patient with a great amount of functional improvement.

Pain: In our study 21(58.33%) hips were completely pain free, 14(38.9%) hips had slight to occasional pain and 1(2.77%) hip had mild pain post op. This was statistically significant ($p<0.05$). Brinker M et al showed in their study of 20 hips that 90% i.e. 18 out of 20 hips had slight or no pain at recent follow up[51]. They also added that there was no significant difference in the pain scores between cemented and uncemented arthroplasty. Bisla et al reported mild or no pain in 94% of 34 cemented arthroplasties[60]. Similarly Halley and Charnley[61] and Wech and Charnley[62] showed no pain in all their 17 and 33 cases respectively. Walker and Sledge showed no pain in 97% of 29 hips following cemented THA[63]. Calin and Elswood showed a complete relief in pain in 89% or 123 of 138 hips[2]. However Bhan S et al showed appearance of pain in 37 (38%) of 92 hips following uncemented arthroplasty. This was attributed to the fact that the patients in his study had bony ankylosis and had no preoperative

pain. He also suggests that the patient be counseled for the post operative pain[50]. We also noticed that the patients who had undergone uncemented arthroplasty had a less significant improvement in pain scores post op. This could be attributed to the fact that this group had a much worse pain score to start with preoperatively and the result may not reflect on the implant used.

Hip range of motion: In our study the mean preoperative range of motion improved from 32.5° to 184.3° at follow up. The mean improvement in the range of motion being 151.8°. This was a significant improvement ($P<0.05$). Bhan S et al in their study of 54 patients and 92 ankylosed hips showed a post operative range of motion of 156.2°[50]. Sochart et al showed in his study of 43 cemented hips that the mean post operative range of motion improved to a score of 5 (160°-216°)[42]. Kilgus et al[46] in their study showed a post operative range of motion of 176° and Bisla et al[60] in their study showed a post operative range of motion of 147.6°.

These ranges of motions were lesser that the ranges of motion attained in hip arthroplasty for other indications such as hip arthroses, as there are other factors that cause a lower post operative range of motion in patients with ankylosing spondylitis. Kilgus in his study identified causes which may produce a poor postoperative range of motion such as formation of severe heterotopic ossification, post operative infection, previous operations on the hip and a poor

preoperative range of motion. Walker and Sledge demonstrated a post operative range of motion of 168°[63].

Bhan S et al in their study of 19 hips which underwent bipolar hemiarthroplasty showed a post operative range of motion of 182.5° which was attributed to the advantage of using a bipolar hemiarthroplasty[55].

Heterotopic ossification: In our study we noticed seven hips (19.44%) with heterotopic ossification with one hip showing Brooker class 2 HO and six hips showing Brooker class 1 HO.

This was lower than other studies such as Bisla who showed a high rate of HO of upto 61.7%[60]. In our study 16 out of the 24 patients received Indomethacin as prophylaxis. Kilgus et al showed class 1 HO in 25% (13 hips), class 2 HO in 9% (5 hips) and class 3 HO in 9% (5 hips). He further predicted that development of class 1 HO in one hip does not predict development of HO in the other hip. He also concluded that all patients in who class 3 HO developed in one hip class 2 or worse developed in the contralateral hip. His study showed an increased incidence of HO in hips that were pre operatively ankylosed[46]. Joshi et al showed an incidence of 11.6% (21 hips)[49]. Studies by Arden et al showed that 14.35% of the patients developed HO[64]. Welch and Charnley showed an incidence of 1.9% HO in a mixed group of patients with both rheumatoid arthritis and ankylosing spondylitis[62].

Brooker reported a 21% incidence of HO in non ankylosing spondylitis patients although significant amounts of HO were seen only in 9% of the cases[57]. Studies in non ankylosing patients have shown the rate of formation of heterotopic ossification ranged from 8 to 90%. Harris showed an incidence of 14% where only 3% of the patients were significantly affected in terms of range of motion[65].

Bisla concluded from these studies showing formation of HO in mixed groups of patients who had undergone arthroplasty that even though varying degrees of HO occurs in patients with AS it is significant only in a small percentage where it is disabling[60]. Bhan S et al in their study on bipolar hemiarthroplasty showed that there was no formation of HO in their series of 19 hips. He attributed the lack of HO to a shorter operating time, less extensive surgery, less bleeding or hematoma formation, minimal soft tissue dissection and absence of a trochanteric osteotomy[55].

Tang and Chiu reported a 21% incidence of class 3 to 4 HO and attributed it probably to the fact that no prophylaxis was given for the HO. Bhan s et al in their study of 92 hips undergoing uncemented arthroplasty reported an incidence of only 13% (12 hips) which they attributed to the use of Indomethacin as a prophylaxis for a period of two weeks and which they further recommend[50].

However Brinker et al in their study stated that after a complete review of literature they found that the differences in the rates of HO in various studies could result from the use of dissimilar grading systems, differences in techniques, failure in distinguishing between patients who have had one or more surgeries and differences in patient populations. He further states that patients with AS are not specially predisposed to form HO[51]. Giordani et al in their study of 25 THAs showed HO in only one hip and concluded that the incidence of HO in patients with AS is similar with the general population and prophylaxis need not be taken[66].

Even though prophylactic radiation has been shown to be effective in preventing HO, it has shown to decrease the strength of fixation of porous coated implants and produce non union if a trochanteric osteotomy was done[67]. There is also a theoretical risk of developing a malignancy and anaemia following radiation.

Comparing implants: In our study the post operative scores showed an acceptable and a significant outcome for all three implants used i.e. cemented, uncemented and ASR. The BASFI score also showed a significant improvement post operatively for all the implant groups. On comparing the improvement in range of motion between the implants used it was seen that all three groups showed a significant improvement. The improvement in pain was also

significant for each of the groups. On comparing between groups there was no significant difference between groups.

Studies in which cemented and uncemented implants were use did not show an appreciable difference in the outcomes[44,46,58]. Kilgus et al in their study of 53 hips with cemented, uncemented and surface replacement did not show a comparable difference between the three groups, and they however noticed a higher incidence of narrow radiolucencies at the acetabular interface and observe that there may be a greater role in the use of uncemented implants[46].

Table 18: Comparing between implant groups

	Harris hip score pre op	Harris hip score post op	BASFI pre op	BASFI post op	Pre op range of motion in degrees	Post op range of motion in degrees	Pains score pre op	Pain score post op
Cemented	**28.9**	**83**	**7.48**	**4.06**	**15**	**177**	**14.2**	**42.4**
Uncemented	**33**	**76.4**	**6.96**	**4.56**	**35**	**176**	**12**	**38.8**
ASR	**33.27**	**84.82**	**7.83**	**3.42**	**63**	**200**	**13.64**	**42.91**

Comparing single stage and two stage surgeries for patients with bilateral hip involvement: We compared patients with bilateral hip involvement who underwent bilateral surgery in one stage and those that underwent surgery in two stages but found no statistically significant difference between the two groups.

CONCLUSION

Total hip arthroplasty whether it is cemented, uncemented or articular surface replacement is very beneficial to the patient with ankylosing spondylitis who is affected with hip arthritis or ankylosis. A single surgery replacing the hip joint provides a dramatic relief in the patient's pain, improves hip range of motion, improves function, provides independence in activities of daily living and allows return to normal function.

LIMITATIONS OF THE STUDY

1. This is a retrospective study and offers only level three evidence.
2. The functional outcome studied in these patients was done on a small number of patients who came for follow up during the period of the study and may not be representative of the entire group of patient's.
3. This study did not assess the long term survivorship of the implants, rates of revision and other parameters such as subsidence, loosening, wear rate etc.

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Annexure

Preoperative photo of a patient with ankylosing spondylitis:
Fig 1: Sitting in a chair:

Fig 2: Lying on a bed:

Photographs at follow up:

Fig 3: Posterior approach both sides

Fig 4: Flexion both hips

Fig 5: Lying down on a bed and squatting:

Fig 6: Doing a straight leg raise:

X RAY IMAGES

Fig 7: Pre operative X ray with an excision arthroplasty on the opposite side.

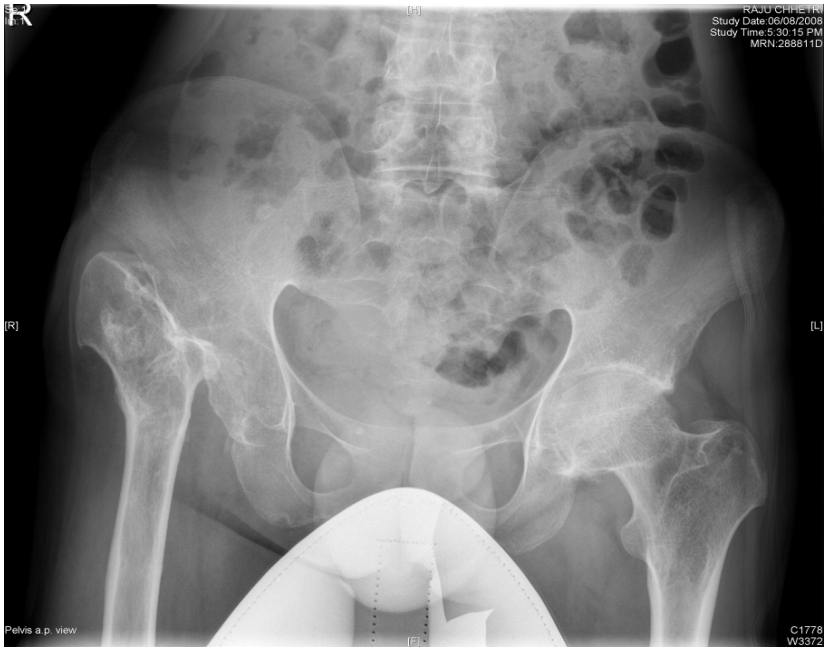

Fig 8: Pre operative X ray with bony ankylosis both hips.

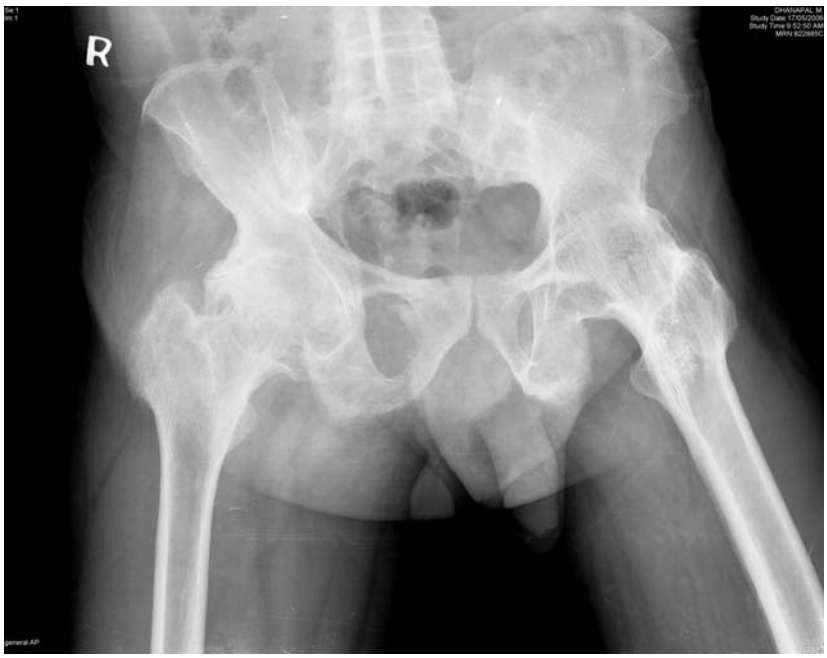

Fig 9: Pre operative X ray

Fig 10: Post operative Xray following Cemented arthroplasty

Fig 11: Pre operative X ray

Fig 12: Post operative X ray following left uncemented arthroplasty.

Fig 13: Pre operative X ray

Fig 14: Post operative X ray following bilateral ASR

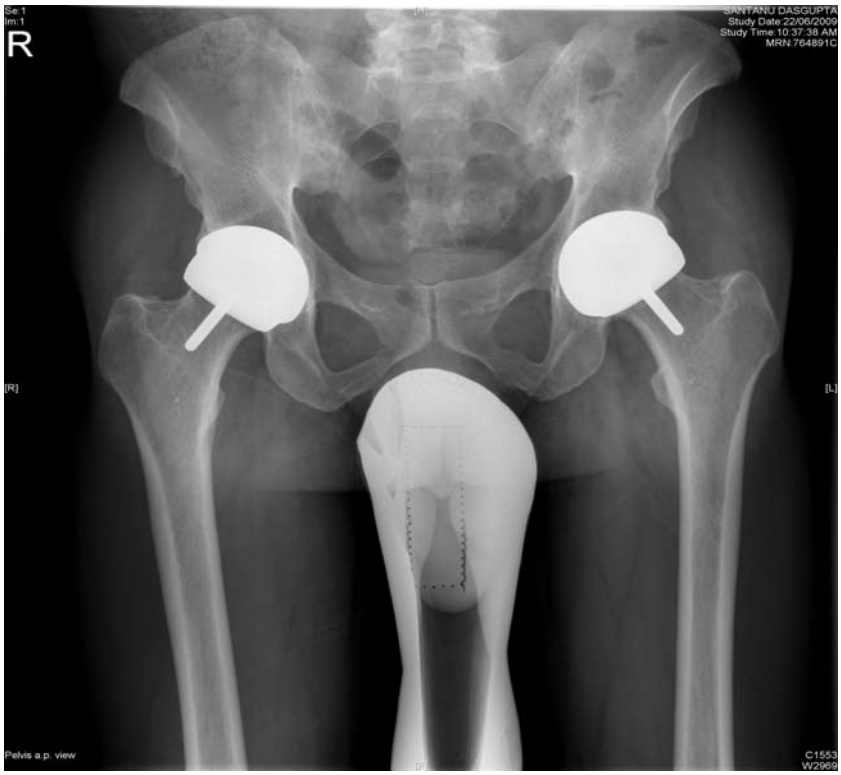

Fig 15: Pre operative X ray

Fig 16: Post op X ray following uncemented metal on metal arthroplasty with stainless steel wire following Split of the Greater trochanter

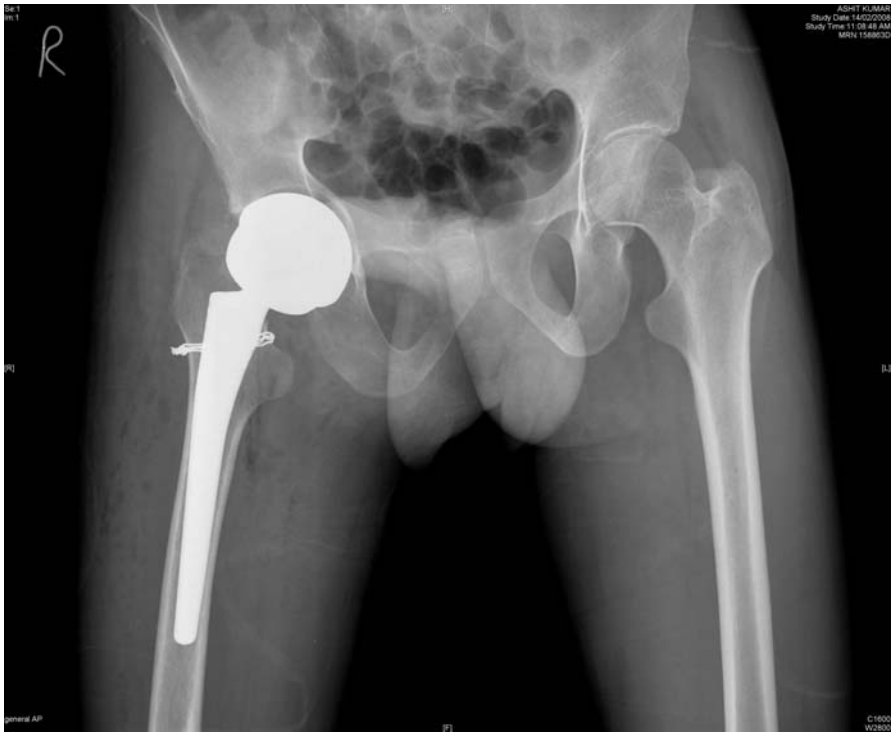

Fig 17: Post op X ray showing Brooker`s class 1 heterotopic ossification

Fig 18: Post op X ray showing Brooker`s class 2 heterotopic ossification

Proforma

No:
Date:
Hospital No:
Name:
Age:
Sex:
Permanent address:

Phone no:
Email ID:
Duration of complaints:
Other comorbidities:

Occupation:
Dates of admission and surgeries done:

Duration of follow up:

Charnley`s class: A □ B □ C □

Operated side: L □ R □ B/L □

Procedure done:

Primary cemented THR □ Primary uncemented THR □

Primary resurfacing arthroplasty □ Primary THR not classified □

Austin Moore prosthesis □ Thompson □

Cemented bipolar □ Uncemented bipolar □

BASFI
Bath Ankylosing Spondylitis Functional Index

Name: _____

Date: _____

Please draw a mark on each line below to indicate your level of ability with each of the following activities in the past 7 days:

		Evaluation by medecin
1	Putting on your socks or tights without help or aids (e.g. sock aid)	
2	Bending forward from the waist to pick up a pen from the floor without an aid	
3	Reaching up to a high shelf without help or aids (e.g. helping hand)	
4	Getting up out of an armless dining room chair without using your hands or any other help	
5	Getting up off the floor without help from lying on your back	
6	Standing unsupported for 10 minutes without discomfort	
7	Climbing 12–15 steps without using a handrail or walking aid, one foot on each step	
8	Looking over your shoulder without turning your body	
9	Doing physically demanding activities (e.g. physiotherapy exercises, gardening or sports)	
10	Doing a full day's activities whether it be at home or at work	

easy 0 2 4 6 8 10 impossible

BASFI = ☐

(sum of answers 1 to 10 divided by 10)

Harris Hip Score

Harris Hip Score

Pain *(check one)*

- ☐ None or ignores it (44)
- ☐ Slight, occasional, no compromise in activities (40)
- ☐ Mild pain, no effect on average activities, rarely moderate pain with unusual activity; may take aspirin (30)
- ☐ Moderate Pain, tolerable but makes concession to pain. Some limitation of ordinary activity or work. May require Occasional pain medication stronger than aspirin (20)
- ☐ Marked pain, serious limitation of activities (10)
- ☐ Totally disabled, crippled, pain in bed, bedridden (0)

Limp

- ☐ None (11)
- ☐ Slight (8)
- ☐ Moderate (5)
- ☐ Severe (0)

Support

- ☐ None (11)
- ☐ Cane for long walks (7)
- ☐ Cane most of time (5)
- ☐ One crutch (3)
- ☐ Two canes (2)
- ☐ Two crutches or not able to walk (0)

Distance Walked

- ☐ Unlimited (11)
- ☐ Six blocks (8)
- ☐ Two or three blocks (5)
- ☐ Indoors only (2)
- ☐ Bed and chair only (0)

Sitting

- ☐ Comfortably in ordinary chair for one hour (5)
- ☐ On a high chair for 30 minutes (3)
- ☐ Unable to sit comfortably in any chair (0)

Enter public transportation

- ☐ Yes (1)
- ☐ No (0)

Stairs

- ☐ Normally without using a railing (4)
- ☐ Normally using a railing (2)
- ☐ In any manner (1)
- ☐ Unable to do stairs (0)

Put on Shoes and Socks

- ☐ With ease (4)
- ☐ With difficulty (2)
- ☐ Unable (0)

Absence of Deformity (All yes = 4; Less than 4 =0)

Less than 30° fixed flexion contracture	☐ Yes	☐ No
Less than 10° fixed abduction	☐ Yes	☐ No
Less than 10° fixed internal rotation in extension	☐ Yes	☐ No
Limb length discrepancy less than 3.2 cm	☐ Yes	☐ No

Range of Motion (*Indicates normal*)

- Flexion (*140°) _____
- Abduction (*40°) _____
- Adduction (*40°) _____
- External Rotation (*40°) _____
- Internal Rotation (*40°) _____

Range of Motion Scale

211° - 300° (5)	81° - 100 (2)
161° - 210° (4)	31° - 80° (1)
101° - 160° (3)	0° - 30° (0)

Range of Motion Score _____

Total Harris Hip Score _____

Consent form

Dr.Prabhu L Joseph
PG registrar
Dept of Orthopaedics,
CMC Vellore 632004,
India.
E mail ID- *prabhujoseph24@rediffmail.com.*

Subject's Name: _____

Address:

Date of Birth / Age: _____

Phone:

The purposes of this project are:
To study the functional outcome, in patients with ankylosing spondylitis, following hip arthroplasty.
You will undergo relevant clinical examination, and will be required to answer a questionnaire.
However benefit from this study to the patient for cure/improvement is uncertain.
You are encouraged to ask any questions at any time about the nature of the study and the methods that I am using.
1) Your real name will not be used at any point of information collection, or in the written case report;
2) Your participation in this research is voluntary; you have the right to withdraw at any point of the study, for any reason, and without any prejudice.
I agree to the terms

Respondent signature _____ Date _____

Researcher _____ Date _____